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Philos. Transact. N° 347

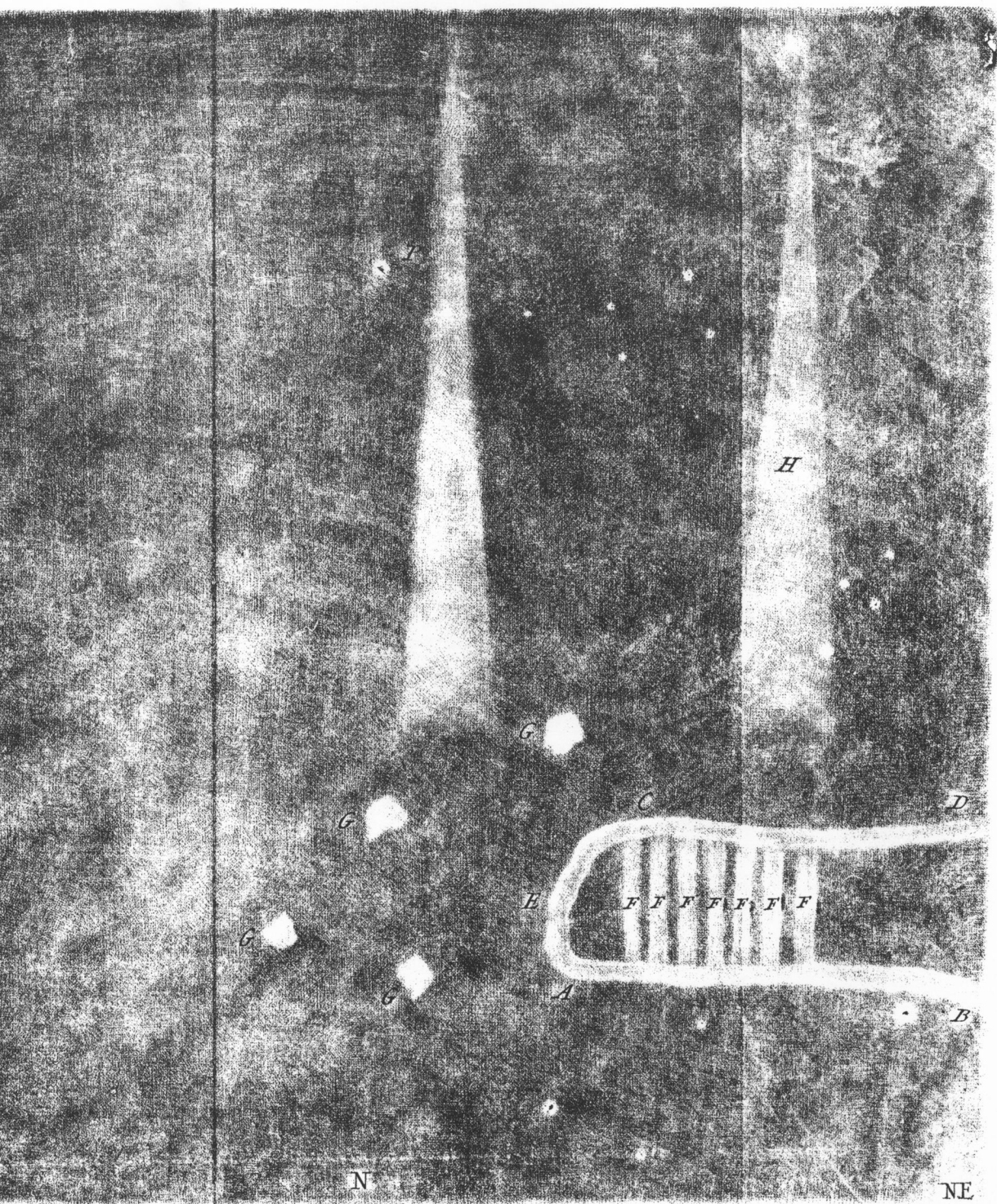
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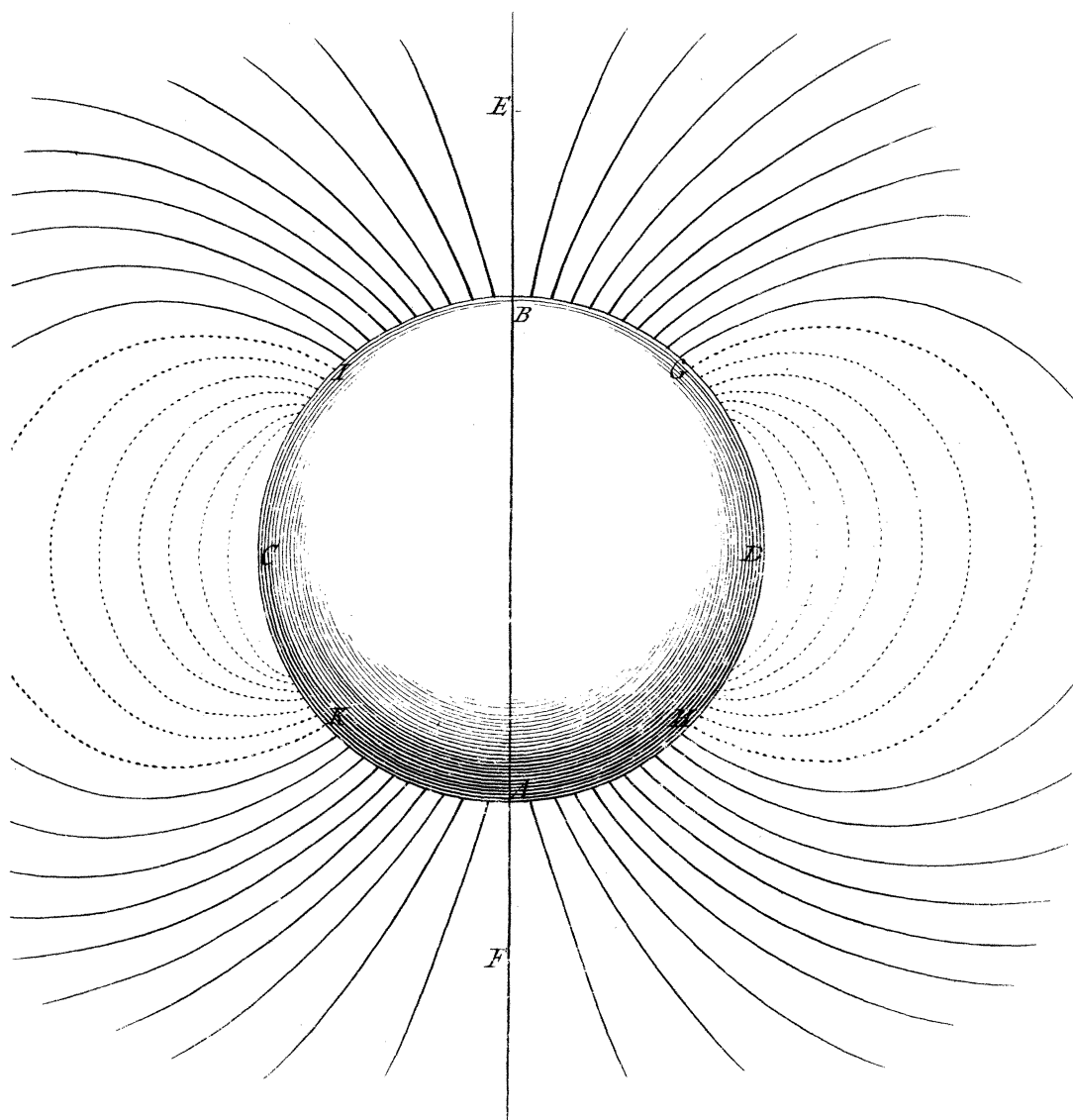
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V. *An Account of the late surprizing Appearance of the Lights seen in the Air, on the sixth of March last; with an Attempt to explain the Principal Phænomena thereof; As it was laid before the Royal Society by Edmund Halley, J. V. D. Savilian Professor of Geom. Oxon, and Reg. Soc. Secr.*

THE *Royal Society* having received Accounts from very many Parts of *Great Britain*, of the unusual *Lights* which have of late appeared in the *Heavens*; were pleased to signify their Desires to me, that I should draw up a general Relation of the *Fact*, and explain more at large some Conceptions of mine I had proposed to them about it, as seeming to some of them to render a tollerable Solution of the very strange and surprizing *Phænomena* thereof. The Desires of the *Society* having with me the force of Commands, I shall not decline the Task : only premising that if, in delivering the *Etiology* of a Matter so uncommon, never before seen by my self, nor fully described by any either of the Ancients or Moderns, I fail to answer their Expectation or my own Desires; yet 'tis hoped a good History of the *Fact*, deduced partly from our own Observations, and partly collected from the uniform Relations of credible Persons, or from the Letters of such, may not be unacceptable to the Curious; and may perhaps excite the *Genius* of some more able *Meteorologist* to a more satisfactory Enquiry. The Account of this Appearance take as follows.

On

On *Tuesday* the sixth of *March*, *ft. vet.* in the current Year 1716, (the Afternoon having been very serene and calm, and somewhat warmer than ordinary) about the Time it began to grow dark, that is much about 7 of the Clock, not only in *London*, but in all Parts of *England*, where the Beginning of this wonderful Sight was seen; out of what seemed a dusky Cloud, in the N. E. parts of the Heaven and scarce ten Degrees high, the Edges whereof were ringed with a reddish Yellow like as if the Moon had been hid behind it, there arose very long, luminous Rays or Streaks perpendicular to the Horizon, some of which seem'd nearly to ascend to the Zenith. Presently after, that reddish Cloud was swiftly propagated along the Northern Horizon, into the N. W. and still farther Westerly; and immediately sent forth its Rays after the same manner from all Parts, now here, now there, they observing no Rule or Order in their issuing. Many of these Rays seeming to concur near the Zenith, formed there a *Corona*, or Image which drew the Attention of all Spectators, who according to their several Conceptions made very differing Resemblances thereof; but by which compared together, those that saw it not, may well comprehend after what manner it appeared. Some likened it to that Representation of *Glory* wherewith our Painters in Churches surround the Holy Name of God. Others to those radiating *Starrs* wherewith the Breasts of the *Knights* of the most Noble Order of the *Garter* are adorned. Many compared it to the *Concave* of the great *Cupola* of *St. Paul's Church*, distinguished with Streaks alternably Light and obscure: and having in the middle a Space less bright than the rest, resembling the Lantern. Whilst others, to express as well the Motion as Figure thereof, would have it to be like the Flame in an Oven reverberated and rousing against the arched Roof thereof: And some there were that thought it liker to that tremulous

Light

Light which is cast against a Ceiling by the Beams of the Sun, reflected from the Surface of Water in a Basin that's a little shaken; whose reciprocal vibrating Motion it very much imitated. But all agree that this *Spectrum* lasted only a few Minutes, and shew'd it self variously tinged with Colours, Yellow, Red and a dusky Green: Nor did it keep in the same Place; for when first it began to appear, it was seen a little to the Northwards of the *Zenith*, but by degrees declining towards the South, the long *Strie* of Light, which arose from all Parts of the Northern Semicircle of the Horizon, seemed to meet together, not much above the Head of *Castor* or the Northern *Twin*, and there soon disappeared.

After the first *Impetus* of this ascending Vapour was over, the *Corona* we have been describing appeared no more; but still, without any order as to Time, or Place, or Size, luminous *Radii* like the former continued to arise perpendicularly, now oftner and again seldomer, now here, now there, now longer, now shorter, Nor did they proceed at first out of a Cloud, but oftner would emerge at once out of the pure Sky, which was at that time more than ordinary serene and still. Nor were they all of the same Form. Most of them seemed to end in a Point upwards, like erect Cones; others like truncate Cones or Cylinders, so much resembled the long Tails of Comets, that at first sight they might well be taken for such. Again, some of these Rays would continue visible for several Minutes; when others, and those the much greater part, just shew'd themselves and died away. Some seem'd to have little Motion, and to stand as it were fix'd among the Stars, whilst other with a very perceptible Translation moved from East to West under the Pole, contrary to the Motion of the Heavens; by which means they would sometimes seem to run together, and
at

at other times to fly one another ; affording thereby a surprizing Spectacle to the Beholders.

After this Sight had continued about an Hour and a Half, those Beams began to rise much fewer in Number and not near so high, and by degrees that diffused Light, which had illustrated the Northern Parts of the Hemisphere, seemed to subside, and settling on the Horizon formed the Resemblance of a very bright *Crepusculum* : That this was the State of this *Phænomenon*, in the first Hours, is abundantly confirmed by the unanimous Consent and concurring Testimony of several very worthy Persons no ways enclined to deceive. For by the Letters we have received from almost all the extream Parts of the Kingdom, there is found very little Difference in the Description from what appeared at *London* and *Oxford* ; unless that in the North of *England*, and in *Scotland*, the Light seemed somewhat stronger and brighter.

Hitherto I am forced to relate the Observations of others, wherein I fear many very material Circumstances may be omitted : and assuredly I am not a little concern'd that I had no Notice of this Matter, till between Nine and Ten of the Clock, being at that Time at a Friend's House, and no ways suspecting what past without Doors. But upon the first Information of the thing, we immediately ran to the Windows, which hapned to regard the *South* and *South-West* Quarter ; and soon perceived, that though the Sky was very clear, yet it was tinged with a strange sort of Light ; so that the smaller Stars were scarce to be seen, and much as it is when the Moon of four Days old appears after Twilight. And whilst we regarded the Heavens with attention, we perceived a very thin Vapour to pass before us, which arose from the precise *East* part of the *Horizon*, ascending obliquely, so as to leave the Zenith about 15 or 20 Degrees to the Northward. But the swiftness wherewith it proceeded

ded was scarce to be believed, seeming not inferior to that of Lightning; and exhibiting, as it past on, a sort of momentaneous *Nubecula*, which discovered it self by a very diluted and faint Whiteness; and was no sooner formed, but before the Eye could well take it, it was gone, and left no Signs behind it. Nor was this a single appearance; but for several Minutes that we regarded it, about six or seven times in a Minute, the same was again and again repeated; these Waves of Vapour (if I may be allowed to use the Word) regularly succeeding one another, and, as we guess, at intervals very nearly equal; all of them in their Ascent producing a like transient *Nubecula*.

By this particular we were first assured, that the Vapour we saw, whatever it were, became conspicuous by its own proper Light, without help of the Suns Beams: for these *Nubecula* did not discover themselves in any other part of their passage, but only between the *South-East*, and *South*, where being opposite to the Sun they were deepest immerst in the Cone of the Earths Shadow; nor were they visible before or after. Whereas the contrary must have happened, had they borrowed their Light from the Sun.

We then made all the hast we could to a place where there is a free Prospect of the Northern Horizon. Being come there, not much past Ten of the Clock, we found, on the Western Side, *viz.* between the W. and N. W. the Representation of a very bright *Twilight*, contiguous to the Horizon; out of which there arose very long Beams of Light, not exactly erect toward the *Vertex*, but something declining to the South, which ascending by a quick and undulating Motion to a considerable Height, vanished in a little time, whilst others, tho' at uncertain Intervals, supply'd their Place. But at the same time, through all the rest of the Northern Horizon, *viz.* from the North-
West

West to the true East, there did not appear any sign of Light to arise from, or joyn to, the Horizon ; but on the contrary, what appeared to be an exceeding black and dismal Cloud seem'd to hang over all that part of it. Yet was it no Cloud, but only the serene Sky more than ordinary pure and limpid, so that the bright Stars shone clearly in it, and particularly *Cauda Cygni* then very low in the *North* ; the great Blackness manifestly proceeding from the Neighbourhood of the Light which was collected above it. For the Light had now put on a Form quite different from all that we have hitherto described, and had fashioned it self into the Shape of two *Lamina* or Streaks, lying in a Position parallel to the Horizon, whose Edges were but ill terminated. They extended themselves from the *N. by E.* to the *North East*, and were each about a Degree broad ; the undermost about eight or nine Degrees high, and the other about four or five Degrees over it ; these kept their Places for a long time, and made the Sky so light, that I believe a Man might easily have read an ordinary Print by the Help thereof.

Whilst we stood astonished at this surprizing Sight, and expecting what was further to come, the Northern End of the upper *Lamina* by degrees bent downwards, and at length closed with the End of the other that was under it, so as to shut up on the Northside an intermediate Space, which still continued open to the East. Not long after this, in the said included Space, we saw a great Number of small Columns or whitish Streaks to appear suddenly, erect to the Horizon, and reaching from the one *Lamina* to the other ; which instantly disappearing were too quick for the Eye, so that we could not judge whether they arose from the Under or fell from the Upper, but by their sudden Alterations they made such an Appearance, as might well be taken to resemble the Conflicts of Men in Battle.

And much about the same time, to encrease our Wonder, there began on a sudden to appear, low under the Pole and very near due North, three or four lucid *Areas* like Clouds, discovering themselves, in the pure but very black Sky, by their yellowish Light. These, as they broke out at once, so after they had continued a few Minutes, disappeared as quick as if a Curtain had been drawn over them: Nor were they of any determined Figure, but both in Shape and Size might properly be compared to small Clouds illuminated by the full Moon, but brighter.

Not long after this, from above the aforesaid two *Lamine*, there arose a very great *Pyramidal* Figure, like a *Spear*, sharp at the Top, whose Sides were inclined to each other with an Angle of about four or five Degrees, and which seemed to reach up to the Zenith or beyond it. This was carried with an equable and not very slow Motion, from the N. E. where it arose, into the N. W. where it disappeared, still keeping in a perpendicular Situation, or very near it; and passing successively over all the Stars of the *Little Bear*, did not efface the smaller ones in the Tail, which are but of the Fifth Magnitude; such was the extream Rarity and Perspicuity of the Matter whereof it consisted.

This single Beam was so far remarkable above all those that for a great while before had preceeded it, or that followed it, that if the Situation thereof among the Circumpolar Stars had at the same Instant been accurately noted, for Example, at *London* and *Oxford*, whose Difference of *Longitude* is well known, we might be enabled thereby with some certainty to pronounce, by its *diversitas Aspectûs*, concerning the Distance and Height thereof; which were undoubtedly very great, tho' as yet we can no ways determine them. But as this Phænomenon found all those that are skill'd in the Observation of the Heavens unprepared, and unacquainted with what

was

was to be expected ; so it left all of them surprized and astonished at the Novelty thereof. When therefore for the future any such thing shall happen, all those that are curious in Astronomical Matters, are hereby admonished and entreated to set their Clocks to the apparent Time at *London*, for Example, by allowing so many Minutes as is the Difference of Meridians ; and then to note at the End of every half Hour precisely, the exact Situation of what at that time appears remarkable in the Sky ; and particularly the *Azimuths* of those very tall *Pyramids* so eminent above the rest, and therefore likely to be seen furthest : to the intent that by comparing those Observations taken in the same Moment in distant Places, the Difference of their *Azimuths* may serve to determine how far those *Pyramids* are from us.

It being now past Eleven of the Clock, and nothing new offering it self to our View, but repeated *Phases* of the same Spectacle ; we thought it no longer worth while to bear the Chill of the night-Air *sub dio*. Wherefore being returned to my House, I made haste to my upper Windows, which conveniently enough regard the N. E. Parts of Heaven, and soon found that the two *Lamina* or Streaks parallel to the Horizon, of which we have been speaking, had now wholly disappeared ; and the whole Spectacle reduced it self to the Resemblance of a very bright *Crepusculum* settling on the Northern Horizon, so as to be brightest and highest under the Pole it self ; from whence it spread both Ways, into the N. E. and N. W. Under this, in the middle thereof, there appeared a very black Space, as it were the Segment of a lesser Circle of the Sphere cut off by the Horizon. It seemed to the Eye like a dark Cloud, but was not so ; for by the Telescope the small Stars appeared through it more clearly than usual, considering how low they were : and upon this as a *Basis* our *Lumen Auroriforme* rested, which

which was no other than a Segment of a Ring or Zone of the Sphere, intercepted between two parallel lesser Circles, cut off likewise by the Horizon; or, if you please, the Segment of a very broad *Iris*, but of one uniform Colour; *viz.* a Flame-colour inclining to yellow, the Center thereof being about forty Degrees below the Horizon. And above this there were seen some Rudiments of a much larger Segment, with an Interval of dark Sky between, but this was so exceeding faint and uncertain that I could make no proper estimate thereof.

I was very desirous to have seen how this Phænomenon would end, and attended it till near Three in the Morning, and the rising of the Moon: but for above two Hours together it had no manner of Change in its Appearance, nor Diminution nor Encrease of light; only sometimes for very short Intervals, as if new Fuel had been cast on a Fire, the Light seem'd to undulate and sparkle, not unlike the rising of vaporous Smoak out of a great Blaze when agitated. But one thing I assured myself of by this Attendance and Watching, *viz.* that this *Iris*-like Figure did by no means owe its Origine to the Sun's Beams: for that about Three in the Morning, the Sun being in the Middle between the North and East, our *Aurora* had not follow'd him, but ended in that very Point where he then was: whereas in the true North, which the Sun had long past, the Light remained unchanged and in its full Lustre.

Hitherto I have endeavoured by Words to represent what I saw, but being sensible how insufficient such a verbal Description of a thing so extraordinary and unknown may be to most Readers, I have thought fit to annex a Figure exhibiting that particular Appearance of the two *Lamina*, which I saw at *London* between the Hours of Ten and Eleven: more especially because I do

one that has taken notice of it. In this Figure *AB* is the under *Lamina*, somewhat broader and brighter than the upper *CD*: it had near its under Edge the *Lucida Lyra*, and below its Northern Extremity, on the Left-hand, *Cauda Cygni*: and as well above and below these, as in the intermediate Space between them, and indeed all round about that Part of the Heavens, the Sky was so unusually dark and black, as if all that *exotick Light* that had shew'd it self before, had been then collected into those two Streaks. Only at *Q* between the West and Northwest and no where else, out of a Brightness adjoining to the Horizon, there arose conical Beams as *M, L, N*, after the same manner as at first.

Whilst we stood looking on, the Streak *CD* at its Northern End bent downward, and joyned with the Under *AB* at *E*, and included the Space *DC EAB*, which still kept open at the other End towards the East. And in the mean time, out of the very clear Sky, some luminous Spots, situated and figured as in the Scheme at *G, G, G, G*, presented themselves to the Eye, in Colour much like the *Lamina*. These did not shew themselves all together, but came successively, yet so as two or three of them were seen at a time; and as their coming was instantaneous, so they went away in a Moment. At the same time likewise, the several little white Columns marked *F, F, F, F*, occupied that Part of the Space between the two Streaks next to *E*, and by their sudden and very irregular Motion, and the vanishing of some whilst others at the same time emerged, gave occasion to the Conception of those that fancy'd Battles fought in the Air. Lastly from about the middle of *CD*, there arose suddenly a Cone or Obelisk of a pale whitish Light, greater than any we had yet seen, as *H*; which moving from East to West, with a Motion sufficiently regular, was translated to *K*, in the *North West*, and there disappeared.

That

That we might by the same Scheme shew the Appearance of the last Hours, after Midnight ; the Reader is desired to take notice that we have made the Light at 2, much bigger than what appeared in the West about Ten of the Clock ; so as to represent truly that other. In this Case the Point 2 must, by the Imagination, be supposed transferred to the Intersection of the Horizon and Meridian under the Pole. And that we might the better be understood in what follows, we have made this short Recapitulation as annex'd to, and explicative of, the Scheme, which could by no means be contrived to answer the wonderful Variety this Phænomenon afforded ; since even the Eye of no one single Observer, was sufficient to follow it in the Suddenness and Frequency of its Alterations.

Thus far I have attempted to describe what was seen, and am heartily sorry I can say no more as to the first and most surprizing Part thereof, which however frightful and amazing it might seem to the vulgar Beholder, would have been to me a most agreeable and wish'd for Spectacle ; for I then should have contemplated *propriis oculis* all the several Sorts of Meteors I remember to have hitherto heard or read of. This was the only one I had not as yet seen, and of which I began to despair, since it is certain it hath not happen'd to any remarkable Degree in this Part of *England* since I was born ; nor is the like recorded in the *English Annals* since the Year of our Lord 1574, that is above One Hundred and Forty Years ago, in the Reign of Queen *Elizabeth*. Then, as we are told by the Historians of those times, *Cambden* and *Stow*, Eye-Witnesses of sufficient credit, for two Nights successively, *viz.* on the 14th and 15th of *November* that Year, much the same wonderful Phænomena were seen, with almost all the same Circumstances as now.

Nor

Nor indeed, during the Reign of that glorious Princess, was this so rare a Sight as it has been since. For we find in a Book entituled a *Description of Meteors*, reprinted at London in the Year 1654, whose Author writes himself *W.F.D.D.* that the same thing, which he there calls *Burning Spears*, was seen at London on January 30. 1560; and again by the Testimony of Stow, on the 7th of October 1564. And from foreign Authors we learn, that in the Year 1575, the same was twice repeated in Brabant, viz. on the 13th of February and 28th of September; and seen and described by Cornelius Gemma, Professor of Medicine in the University of Lovain, and Son of Gemma Frisus the Mathematician. He, in a Discourse he wrote of the Prodigies of those Times, after several ill-boding Prognosticks, thus very properly describes the Cupola and Corona that he saw in the Chasma (as he calls it) of February. *Paulo post undecunque surgentibus Hastis & flammis novis, flagrare cælum à Borea parte usque ad verticem videbatur: ac denique ne nihil quæ contigerunt hæcenus præfiguratum antea videretur, conversa est Cæli facies, per horæ spatium, in Fritilli aleatorii speciem peregrinam; alternantibus sese caruleo & candido, non minore vertigine motusque celeritate, quam solares radii solent, quoties ab objecto speculo regeruntur.* Here it is not a little remarkable, that all these four already mentioned fell exactly upon the same Age of the Moon, viz. about two Days after the Change.

As to the other of September in the same Year 1575, these are the Words of Gemma. *Minus quidem horrendum, sed varia tamen magisque confusa nobis apparuit alterius Chasmatis forma, quarto Calendas Octobreis subsecuti, statim ab occasu Solis. Nam in illo visi sunt arcus illustres plurimi, ex quibus Hastæ sensim eminentes, Urbesque turritæ & Acies militares. Erant hinc radiorum excursus quaquaversum, & nubium fluctus & prælia: insectabantur invicem & fugiebant, facta in orbem conversione mirabili.* From hence 'tis ma-

nifest that this *Phænomenon* appeared in our Neighbourhood three several Times, and that with considerable Intervals, within the Campass of one Year; though our *English* Historians have not recorded the two latter; nor did *Gemma* see that of *November* 1574, as 'tis most likely by reason of Clouds. After this, in the Year 1580. we have the Authority of *Michael Mæstlin*,* (himself a good Astronomer, and still more famous for having had the honour to be the great *Kepler's* Tutor in the Sciences) that at *Baknang* in the Country of *Wirtemberg* in *Germany*, these *Chasmata*, as he likewise styles them, were seen by himself no less than seven times within the Space of twelve Months. The first of these, and most considerable, fell out on the very same Day of the Month with ours, viz. on *Sunday* the sixth of *March*, and was attended with much the same Circumstances, which, for Brevity's sake, I omit. And again the same things were seen in a very extraordinary manner on the 9th of *April* and 10th of *September* following: but in a less degree, on the 6th of *April*, 21st of *September*, 26th of *December* and 16th of *February*, 1581: the last of which, and that of the 21st of *September* must needs have been more considerable than they then appeared, because the Moon being near the Full, necessarily effaced all the fainter Lights. Of all these however no one is mentioned in our Annals to have been seen in *England*, nor in any other place that I can find; such was the neglect of curious matters in those Days.

The next in order that we hear of, was that of the Year 1621, on *September* the 2d. st. vet. seen all over *France*, and well described by *Gassendus* in his *Physicks*, who gives it the Name of *Aurora Borealis*. This, tho' little inferiour to what we lately saw, and appearing to the Northwards both of *Rouen* and *Paris*, is no where said to have been observed in *England*, over which the Light seemed to lie. And since then for above 80 Years, we have no Account

* M. Mæstlin. lib. de Cometa 1580.

of any such Sight either from home or abroad ; notwithstanding that for above half that time, these *Philosophical Transactions* have been a constant Register of all such extraordinary Occurrences. The first we find on our Books, was one of small Continuance seen in *Ireland* by Mr. Neve on the 16th of November 1707. of which see *Phil. Transf.* No. 320. And in the *Miscellanea Berolinensia* published in 1710, we learn that in the same Year 1707, both on the 24th of January and 18th of February, *scilicet*. something of this kind was seen by M. Olaus Römer at *Copenhagen* : and again on the 23d of February, the same excellent *Astronomer* observed there such another Appearance, but much more considerable ; of which yet he only saw the Beginning, Clouds interposing. But the same was seen that Night by Mr. Gotfried Kirch, at *Berlin* above 200 Miles from *Copenhagen*, and lasted there till past Ten at Night. To these add another small one of short Duration, seen near *London*, a little before Midnight between the Ninth and Tenth of August 1708, by the Right Reverend Philip Lord Bishop of *Hereford*, and by his Lordship communicated to the *Royal Society* : so that, it seems, in little more than eighteen Months this sort of Light has been seen in the Sky, no less than five times ; in the Years 1707 and 1708.

Hence we may reasonably conclude that the Air, or Earth, or both, are sometimes, though but seldom and with great Intervals, disposed to produce this Phenomenon : for though it be probable that many times, when it happens, it may not be observed, as falling out in the Day-time, or in cloudy Weather, or bright Moon-shine : yet that it should be so very often seen at some times and so seldom at others, is what cannot well be that way accounted for. Wherefore casting about and considering what might be most probably the *Material Cause* of these Appearances ; what first occur'd was the Vapour of Water

rarified exceedingly by subterraneous Fire, and tinged with sulfureous Steams; which Vapour is now generally taken by our Naturalists to be the Cause of *Earthquakes*. And as Earthquakes happen with great Uncertainty, and have been sometimes frequent in Places, where for many Years before and after they have not been felt; so These, which we might be allowed to suppose produced by the Eruption of the pent Vapour through the Pores of the Earth, when it is not in sufficient Quantity, nor sudden enough to shake its Surface, or to open it self a Passage by rending it. And as these Vapours are suddenly produced by the Fall of Water upon the nitro-sulphurous Fires under Ground, they might well be thought to get from thence a Tincture which might dispose them to shine in the Night, and a Tendency contrary to that of Gravity; as we find the Vapours of *Gun-powder*, when heated in *Vacuo*, to shine in the Dark, and ascend to the Top of the Receiver though exhausted: the Experiment of which I saw very neatly performed by Mr. *J. Whiteside* Keeper of *Ashmole's Museum* in *Oxford*.

Nor should I seek for any other Cause than this, if in some of these Instances, and particularly this whereof we treat, the Appearance had not been seen over a much greater Part of the Earth's surface that can be thus accounted for. It having in this last been visible from the West Side of *Ireland* to the Confines of *Russia* and *Poland* on the East (nor do we yet know its Limits on that Side) extending over at least thirty Degrees of Longitude; and in Latitude, from about fifty Degrees over almost all the North of *Europe*; and in all Places exhibiting at the same time the same wonderful Circumstances, as we are informed by the Publick News. Now this is a Space much too wide to be shaken at any one Time by the greatest of Earthquakes, or to be affected by the Perspiration of that Vapour, which being included and wanting vent,
might

might have occasioned the Earth to tremble. Nor can we this Way account for that remarkable Particular attending these Lights, of being always seen on the Northside of the Horizon, and never to the South.

Wherefore laying aside all hopes of being able to explain these Things by the ordinary Vapours or Exhalations of the Earth or Waters, we are forced to have recourse to other sorts of *Effluvia* of a much more subtile Nature, and which perhaps may seem more adapted to bring about those wonderful and surprizingly quick Motions we have seen. Such are the *Magnetical Effluvia*, whose Atoms freely permeate the Pores of the most solid Bodies, meeting with no Obstacle from the Interposition of Glass or Marble or even Gold it self. These by a perpetual Efflux do, some of them, arise from the Parts near the Poles of the Magnet, whilst others of the like Kind of Atoms, but with a contrary Tendency, enter in at the same Parts of the Stone, through which they freely pass; and by a kind of Circulation surround it on all Sides, as with an Atmosphere, to the Distance of some Diameters of the Body. This thing *des Cartes* has endeavoured to explain (*Princip. Philosoph. Lib. IV.*) by the *Hypothesis* of the Circulation of certain skrewed or *striate Particles*, adapted to the Pores they are to enter.

But without enquiring how sufficient the *Cartesian Hypothesis* may be for answering the several Phænomena of the Magnet: that the Fact may be the better comprehended, we shall endeavour to exhibit the manner of the Circulation of the Atoms concerned therein, as they are exposed to view, by placing the Poles of a *Terrella* or *Spherical Magnet* on a Plane, as the Globe on the Horizon of a Right Sphere: Then strewing fine Steel dust or Filings very thin on the Plain all round it, the Particles of Steel, upon a continued gentle knocking on the under side of the Plain, will by degrees conform themselves
to

to the Figures in which the Circulation is performed. Thus in *Fig. II.* Let *A B C D* be a *Terrella*, and its Poles *A* the South, and *B* the North ; and by doing as prescribed, it will be found that the Filings will lie in a Right Line perpendicular to the Surface of the Ball, when in the Line of the Magnetical Axis continued. But for about forty five Degrees on either side, from *B* to *G* or *I*, and from *A* to *H* or *K*, they will form themselves into Curves, more and more crooked as they are remoter from the Poles ; and withall more and more oblique to the Surface of the Stone : as our Figure truly represents, and as may readily be shewn by the *Terrella* and *Apparatus* for that Purpose in the *Repository* of the *Royal Society* Hence it may appear how this exceeding subtile Matter revolves ; and particularly how it permeates the Magnet with more force and in greater Quantity in the circumpolar Parts, entring into it on the one side, and emerging from it on the other, under the same oblique Angles : whilst in the middle Zone about *C* and *D*, near the Magnet's Equator (if I may use the Word) very few if any of these Particles do impinge. and those very obliquely.

Now by many and very evident Arguments it appears that our *Globe* of *Earth* is no other than one great Magnet, or (if I may be allowed to alledge an Invention of my own) rather two ; the one including the other as the *Shell* includes the *Kernel* (for so and not otherwise we may explain the changes of the Variation of the Magnetical Needle) but to our present Purpose the Result is the same. It suffices that we may suppose the same sort of Circulation of such an exceeding fine Matter to be perpetually performed in the *Earth*, as we observe in the *Terrella* ; which subtile Matter freely pervading the Pores of the *Earth*, and entring into it near its Southern Pole, may pass out again into the *Ether*, at the same Distance from the Northern, and with a like Force ; its Direction being still

still more and more oblique, as the Distance from the Poles is greater. To this we beg leave to suppose, that this subtle Matter, no otherways discovering it self but by its Effects on the Magnetick Needle, wholly imperceptible and at other times invisible, may now and then, by the Concourse of several Causes very rarely coincident, and to us as yet unknown, be capable of producing a small Degree of Light; perhaps from the greater Density of the Matter, or the greater Velocity of its Motion: after the same manner as we see the *Affluvia* of *Electrick* Bodies by a strong and quick Friction emit Light in the Dark: to which sort of Light this seems to have a great Affinity.

This being allowed me, I think we may readily assign a Cause for many of the strange Appearances we have been treating of, and for some of the most difficult to account for otherwise; as why these Lights are rarely seen any where else but in the North and never, that we hear of, near the Equator: as also why they are more frequently seen in *Iceland* and *Groenland*, than in *Norway*, though nearer the *Pole* of the *World*. For the Magnetical Poles, in this Age, are to the Westward of our Meridian, and more so of that of *Norway*, and not far from *Groenland*; as appears by the Variation of the Needle this Year observed, full twelve Degrees at *London* to the West.

The erect Position of the luminous Beams or *Striae* so often repeated that Night, was occasioned by the rising of the Vapour or lucid Matter nearly perpendicular to the Earth's Surface. For that any Line erected perpendicularly upon the Surface of the Globe, will appear erect to the Horizon of an Eye placed any where in the same spherical Superficies; as *Euclid* demonstrates in a Plain, that any Line erected at Right Angles to it, will appear to be perpendicular to that Plain from any Point thereof. That it should be so in the Sphere is a very pretty Proposition,

not very obvious, but demonstrated from *Prop. 5. Lib. I. Theodosii Spheric.* For by it all Lines erect on the Surface pass through the Center, where meeting with those from the Eye, they form the Plains of Vertical Circles thereto. And by the Converse hereof it is evident, that this luminous Matter arose nearly perpendicular to the Earth's Surface, because it appeared in this erect Position. And whereas in this Appearance (and perhaps in all others of the Kind) those Beams which arose near the *East* and *West*, as *L, M, N*, were furthest from the Perpendicular, on both sides inclining towards the *South*, whilst those in the *North* were directly upright: the cause thereof may well be explained by the Obliquity of the Magnetical Curves, making still obtruser Angles with the Meridians of the *Terrella*, as they are further from its Poles.

Hence also it is manifest how that wonderful *Corona* that was seen to the Southwards of the *Vertex*, in the Beginning of the Night, and so very remarkable for it's tremulous and vibrating Light, was produced; to wit, by the Concourse of many of those Beams arising very high out of the circumjacent Regions, and meeting near the Zenith: the *Effluvia* whereof they consisted mixing and interfering one with another, and thereby occasioning a much stronger but uncertain wavering Light. And since it is agreed by all our Accounts that this *Corona* was tinged with various Colours, 'tis more than probable that these Vapours were carried up to such a Height, as to emerge out of the Shadow of the Earth, and to be illustrated by the direct Beams of the Sun: whence it might come to pass that this first *Corona* was seen coloured and much brighter than what appeared afterwards in some Places, where the Sight thereof was more than once repeated, after the Sun was gone down much lower under the Horizon. Hence also it will be easily understood that this *Corona* was not one and the same in all Places, but was
diffc-

different in every differing Horizon; exactly after the same manner as the Rainbow seen in the same Cloud is not the same Bow, but different to every several Eye.

Nor is it to be doubted, but the Pyramidical Figure of these Ascending Beams is Opticall: since according to all likelyhood they are parallel-sided, or rather tapering the otherway. But by the Rules of Perspective, their Sides ought to converge to a Point, as we see in Pictures the Parallel Borders of streight Walks, and all other Lines parallel to the Axis of Vision, meet as in a Center. Wherefore those Rays which arose highest above the Earth and were nearest the Eye, seemed to terminate in Cusps sufficiently acute, and have been for that reason supposed by the Vulgar to represent *Spears*. Others seen from afar, and perhaps not rising so high as the former, would terminate as if cut off with Plains parallel to the Horizon, like truncate Cones or Cylinders: these have been taken to look like the Battlements and Towers on the Walls of Cities fortified after the ancient manner. Whilst others yet further off, by reason of their great Distance, good part of them being intercepted by the Interposition of the Convexity of the Earth, would only shew their pointed Tops, and because of their Shortness have gotten the Name of *Swords*.

Next the Motion of these Beams, furnishes us with a new and, as it seems to me, most evident Argument to prove the diurnal Rotation of the Earth: (though that be a matter which, at present, is generally taken by the Learned to be past dispute) For those Beams which rose up to a Point, and did not presently disappear, but continued for some time, had most of them a sensible Motion, from East to West, contrary to that of the Heavens; the biggest and tallest of them, as being nearest, swiftest; and the more remote and shorter, slower. By which means, the one overtaking the other, they would some-

times seem to meet and jostle ; and at other times to separate, and fly one another. But this Motion was only Optical, and occasioned by the Eye of the Spectator being carried away with the Earth into the East ; whilst the exceeding rare Vapour of which those Beams did consist, being, as I take it, raised far above the Atmosphere, was either wholly left behind, or else followed with but part of its Velocity, and therefore could not but seem to recede and move the contrary Way. And after the same manner as the Stars that go near the Zenith, pass over those Vertical Circles which border on the Meridian, much swifter than those Stars which are more distant therefrom ; so these luminous Rays would seem to recede faster from East to West, as their Bases were nearer the Eye of the Spectator ; and *è contra*, slower as they were further off.

Nor are we to think it strange, if after so great a Quantity of luminous Vapour had been carried up into the Ether out of the Pores of the Earth, the Cause of its Effervescence at length abating, or perhaps the Matter thereof consumed ; these *Effluvia* should at length subside, and form those two bright *Lamina* which we have described, and whose Edges being turn'd to us were capable to emit so much Light that we might read by them. I choose to call them *Lamina*, because, without doubt, though they were but thin, they spread Horizontally over a large Tract of the Earth Surface. And whilst this luminous Matter dropt down from the upper Plate to the under, the many little white Columns were formed between them by its Descent, only visible for the Moment of their Fall. These by the Swiftness with which they vanished and their great Number, shewing themselves and disappearing without any order, exhibited a very odd Appearance ; those on the Right seeming sometimes to drive and push those on the left, and *vice versa*.

I have been obliged to omit several Particulars of less moment : But these are the principal Phænomena ; of whose Causes I should have more willingly and with more certainty given my Thoughts, if I had had the good luck to have seen the whole from Beginning to end ; and to have added my own Remarks to the Relations of others : and especially if we could by any means have come at the Distances thereof. If it shall by any be thought a hard Supposition that I assume the *Effluvia* of the Magnetical Matter for this purpose, which in certain Cases may themselves become luminous, or rather may sometimes carry with them out of the Bowels of the Earth a sort of Atoms proper to produce Light in the Ether. I answer that we are not as yet informed of any other Kinds of *Effluvia* of terrestrial Matter which may serve for our purpose, than those we have here considered, *viz.* the Magnetical Atoms, and those of Water highly rarified into Vapour. Nor do we find any thing like it in what we see of the Celestial Bodies, unless it be the *Effluvia* projected out of the Bodies of Comets to a vast Height, and which seem by a *Vis centrifuga* to fly with an incredible Swift-ness the Centers both of the Sun and Comet, and to go off into Tails of a scarce conceivable Length. What may be the Constitution of these Cometical Vapours, we Inhabitants of the *Earth* can know but little, and only that they are evidently excited by the Heat of the Sun ; whereas this Meteor, if I may so call it, seldom is seen but in the polar Regions of the World, and that most commonly in the Winter Months. But whatever may be the Cause thereof, if this be not, I have followed the old Axiom of the Schools. *Entia non esse temere neque absque necessitate multiplicanda.*

Lastly I beg leave on this Occasion to mention what, near 25 Years since, I publish'd in No 95. of these *Transactions*, *viz.* That supposing the *Earth* to be concave,

with a lesser Globe included, in order to make that inner Globe capable of being inhabited, there might not improbably be contained some luminous *Medium* between the Balls, so as to make a perpetual Day below. That very great Tracts of the Etherial Space are occupied by such a shining *Medium* is evident from the Instances given in the first Paper of this *Transaſtion*: And if ſuch a *Medium* ſhould be thus incloſed within us; what ſhould hinder but we may be allowed to ſuppoſe that ſome parts of this lucid Subſtance may, on very rare and extraordinary Occaſions, tranſude through and penetrate the *Cortex* of our *Earth*, and being got looſe may afford the Matter whereof this our *Meteor* conſiſts. This ſeems favoured by one conſiderable Circumſtance, *viz.* that the *Earth*, becauſe of its diurnal Rotation, being neceſſarily of the Figure of a Flat *Spheroid*, the thickneſs of the *Cortex*, in the *Polar* Parts of the Globe, is conſiderably leſs than towards the *Equator*; and therefore more likely to give Paſſage to theſe Vapours; whence a reaſon may be given why theſe Lights are always ſeen in the North. But I deſire to lay no more ſtreſs upon this Conceit than it will bear.

It having been noted that in the Years 1575 and 1580, wherein this Appearance was frequent, that it was ſeen not far from the Times of the two Equinoxes; it may be worth while for the Curious, to beſtow ſome Attention on the Heavens in the Months of *September* and *October* next; and in caſe it ſhould again happen, to endeavour to obſerve, by the Method I have here laid down, what may determine, with ſome degree of Exactneſs, the Diſtance and Height thereof; without which we can ſcarce come to any juſt Concluſion.

F I N I S.

Errata. No. 346. p. 383. l. 18. read 234. p. 408. l. 20.
read, proceed, as at firſt.